Arch Osteoporos (2017) 12: 36
DOI 10.1007/s11657-017-0330-7

ORIGINAL ARTICLE

Awareness of osteoporosis among female head of household: an Iranian experience

Pouria Khashayar[1] · Mostafa Qorbani[2,3] · Abbasali Keshtkar[4] · Patricia Khashayar[5,6] · Amir Ziaee[7] · Bagher Larijani[8]

Received: 4 November 2016 / Accepted: 27 March 2017 / Published online: 6 April 2017

Abstract

Summary More than 81% of the studied women had a poor knowledge of different aspects of osteoporosis and its complications, suggesting that more educational programs targeting women in particular are needed to help improve the osteoporosis practice in the societies and reduce the burden of the disease.

Purpose The family structure has changed considerably in the past decade. But, women from Iran and many countries in the region and even families with similar cultural background living in other parts of the world are still responsible for childcare as well as the lifestyle adapted by the family. The present study was conducted to assess the awareness of the female head of household of osteoporosis and its complications.

Methods As part of a population-based study in two Iranian cities, Arak and Sannandaj, to study osteoporosis and its risk factors, a questionnaire on the knowledge of female head of households of osteoporosis and its complications was completed. The subsample filled out the knowledge survey along with the questionnaire on their demographic data, socioeconomic status (SES), reproductive factors, bone-related lifestyle habits, family and personal medical history, medication use, and compliance with osteoporosis medication (if used) as well as a FFQ filled out for all the 2100 participants. They also underwent a bone mineral density (BMD) test, and their serum levels of vitamin D were calculated. These data were then used to assess the factors affecting their awareness level.

Results The knowledge of 81.3% (473) of the studied women was found to be poor on different aspects of osteoporosis and its complications. Multivariate analysis revealed that each level increase in vit D intake tertile increases the chance of higher awareness level in K-Total by 1.5 times. Each level increase in physical activity tertile was associated with a 30.6% lower chance of having a good knowledge.

Conclusion Considering the poor awareness level of the studied women and their poor practice of bone healthy behavior, one could conclude that more programs are needed or the content/delivery style of the existing ones should be optimized.

Electronic supplementary material The online version of this article (doi:10.1007/s11657-017-0330-7) contains supplementary material, which is available to authorized users.

✉ Bagher Larijani
larijanib@tums.ac.ir

[1] Faculty of Medicine, Qazvin University of Medical Sciences, Tehran, Iran

[2] Department of Community Medicine, Alborz University of Medical Sciences, Karaj, Iran

[3] Department of Epidemiology and Biostatistics, Iran University of Medical Sciences, Tehran, Iran

[4] Department of Health Sciences Education Development, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

[5] Osteoporosis Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

[6] Center for Microsystems Technology, Imec and Ghent University, Zwijnaarde, Ghent, Belgium

[7] Growth and Development Research Center, Iran University of Medical Sciences, Tehran, Iran

[8] Endocrinology and Metabolism Research Center, Endocrinology and Metabolism Clinical Sciences Institute, Tehran University of Medical Sciences, Tehran, Iran

Keywords Osteoporosis · Awareness · Vitamin D deficiency

Introduction

Annually, 50,000 osteoporotic hip fractures occur in Iran, and in view of the demographic transition in the country, more than 62,000 osteoporotic hip fractures are expected to occur alone in 2020, if the incidence rate of such fractures remains constant [1]. This is while many studies have reported that more than 80% of the Iranian adults suffer from varying degrees of vitamin D deficiency [2, 3]. Apart from poor diet and the aging population, the sedentary lifestyle and other unhealthy behavior such as smoking that negatively affect bone are among other factors aggravating the surge in the number of osteoporosis sufferers in the country in the near future. As a result, osteoporosis is considered as a health priority, and the healthcare system is trying to overcome this problem in different ways.

Studies from different centers worldwide have pointed out the low awareness of osteoporosis, its contributing factors, and preventive measures among not only general public but also health professionals, suggesting that spreading awareness is an important tool in warranting better attitude and practice of osteoporosis. This could lead to the final goal of improving the quality of life and reducing the burden of the disease [4, 5]. The first step is to define the shortcomings that need to be addressed and then organizing educational programs at national and transnational levels [6, 7].

During the recent years, similar to the process that has occurred in Europe, Iranian families likewise many other countries in the region have been passing from traditional statue to modernism [8, 9]. Literacy, urbanization, multimedia, globalization, and westernization are believed to be the underlying causes of the change in this direction. Regardless of how much the families have changed, women from Iran and many countries in the region and even families with similar cultural background living in other parts of the world are still responsible for not only childcare but also the general lifestyle adapted by the family. This points out their important role in adopting preventive measures to reduce osteoporosis risk in the long run, as many studies have clearly stated that osteoporosis prevention starts in adolescence [10]. The present study thus was conducted to assess the awareness of the female head of household of osteoporosis and its complications.

Material and methods

The present study was conducted based on the information gathered through the third phase of the Iranian Multicenteric Osteoporosis Study (IMOS) conducted in two provinces, Markazi (Arak) and Kurdestan (Sannandaj), in 2010. The details of this population-based study are explained elsewhere [11].

In brief, the study was conducted on the Iranian adults aged 20 years and over from the urban areas of Arak and Sannandaj. Based on the results of the first two phases of IMOS, which reported the prevalence of osteoporosis at the spine to be about 13%, a sample size of 700 individuals was estimated to be needed in each city [12]. Taking into account a design effect of 1.5, 1050 individuals were recruited from each city.

Data gathering was conducted through a one-stage cluster sampling method. As a result, 70 clusters with 15 individuals in each cluster were recruited. In this regard, a list of the households in each city was prepared based on the results of the latest census. A total of 70 households were randomly selected in each city. Each of these households was considered as a "cluster." All the adults in these families along with the adjacent households, based on the census list, who met the abovementioned inclusion criteria were recruited until 15 individuals were included in each cluster.

The sample size was calculated to guarantee sufficient data to study the prevalence of primary and secondary osteoporosis and their risk factors in the two cities. The sampling system was also chosen to ensure the generalizability of the final results to the whole population of these two cities.

A questionnaire on demographic data, socioeconomic status (SES), reproductive factors, lifestyle habits (sun exposure and physical activity), family and personal medical history, medication use (including the use of calcium (Ca)-vitamin D (vit D) supplements, here shortly referred to as supplement use), and compliance with osteoporosis medication (if used) as well as a food frequency questionnaire (FFQ) on Ca and vit D-rich foods was filled out for all of them. Thereafter, they were referred to lab to measure their bone mineral density (BMD) and serum levels of Ca, 25(OH)D, parathyroid hormone (PTH), alkaline phosphatase (Alk-ph), and bone Alk-ph.

A knowledge questionnaire was filled out only by the female head of household, defined as the women most responsible for maintaining the household, of all the families participating in the IMOS study. This questionnaire was designed to assess the knowledge of osteoporosis and its complications along with its risk and preventive factors and thus was always filled out before the main questionnaire to reduce possible bias.

The questions of the knowledge survey were selected based on a thorough literature search on the subject. Thereafter, an expert panel including an endocrinologist, a rheumatologist, and an epidemiologist assessed the content validity of the questionnaire. The reliability of the questionnaire was tested on a group of patients visiting our osteoporosis outpatient clinic in two consecutive weeks (alpha Cronbach = 0.92).

These questions were evaluated in four different classes (the questionnaire is available as a supplement):

- Knowledge of facts about osteoporosis (K-FX): sum of questions 1 to 5, which mainly assessed knowledge on osteoporosis and its complications.
- Knowledge of risk factors (K-RF): sum of different parts of question 6, which mainly assessed knowledge on risk factors of osteoporosis.
- Knowledge of preventive factors (K-PF): sum of different parts of question 7 and its subsections, which mainly assessed knowledge of preventive factors of osteoporosis.
- Knowledge in total (K-Total): sum of all the questions.

As for K-FX and K-PF, scores lower than or equal to 2 were considered weak. As for K-RF, scores equal to or lower than 5 were classified as weak. In total, those with K-Total scores equal to or lower than 9 were reported to have a weak knowledge of the subject.

According to the World Health Organization (WHO) Study Group recommendation, BMD values were classified as normal, osteopenic, and osteoporotic [13]. Based on 25(OH)D values, subjects were classified as those suffering from vit D deficiency (≤20 ng/mL), insufficiency (20–30 ng/mL), and sufficiency (>30 ng/mL) [3].

As mentioned in the protocol published elsewhere, SES was calculated using principal component analysis (PCA) and using variables including individual's level of education and work experience as well as the individual's and family's economic and social status based on income, education, and occupation [11]. The resulted variable, calculated as score, was designated as the SES and used to divide subjects into SES tertiles (low, medium, high). The use of a constant C (C = 2 in both provinces) greatly reduced the possibility of a negative Z score in our study. PCA was also used to divide other bone healthy behaviors such as exposure to sunlight and physical activity to tertiles (low, medium, high).

Considering the existing guidelines, the recommended daily allowance (RDA) for Ca and vit D in adults is about 1000 mg and 600 IU, respectively [13]. These values were used as a cutoff to divide the participants with sufficient and insufficient intake of Ca and vit D. Considering the fact that neither of the studied women received recommended amounts of vitamin D, the intake tertile, calculated using PCA technique, was used for further comparison.

Continuous and categorical variables are presented as mean (SD) and number (percentage). Continuous and categorical variables were assessed using t test and chi-squared test. Correlation between continuous variables with awareness score was assessed using Pearson correlation test. Logistic regression was used to assess factors influencing awareness level in each category. In this regard, variables with P value <0.2 in the univariate logistic regression were taken into account in the stepwise multivariate logistic regression. P values <0.05 were considered significant. Statistical analysis was performed using SPSS software version 16.

Results

Overall, 581 women with the mean (SD) age of 42.4 (12.2) years were recruited in this study. The demographic data of these women is listed in Tables 1 and 2. About 151 (26%) of these women were postmenopausal, and only 28 (5%) of them were previously diagnosed with osteoporosis. From among them, only one had experienced osteoporotic hip fracture. This is while our results suggested that 48 (8.3%) and 79 (13.6%) of them were suffering from osteoporosis and osteopenia, correspondingly.

About 90 (15.5%) of them were not drinking any milk, and 520 (89.5%) of them were not engaged in any exercise programs. From among those who did exercise, 36 (59%) did weight-bearing exercises.

Based on the results, 21.8% (127 individuals) of the subjects suffered from different degrees of bone loss; varying degrees of vit D deficiency were reported in 79% (460 individuals) of them.

The knowledge of 81.3% (473 individuals) of the studied women was found to be poor of the subject (K-Total) (Table 3). Three hundred seventy three (64.2%) of the studied women reported mass media as the main source of their information. Family physician had not explained osteoporosis to

Table 1 Quantitative demographic data of the studied women

	Mean ± SD	CI 95%	Range	P value[a]
Age (years)	42.4 ± 12.2	41.3–43.4	19–80	0.854
Education level (years)	9.1 ± 5.5	8.7–9.6	0–29	<0.001*
Sun exposure (min/day)	39.1 ± 43.5	35.6–42.7	4–300	0.007*
Physical activity (min/week)	210.9 ± 188.4	201.7–240.4	10–1440	0.027*
Vitamin D intake (IU/week)	408.3 ± 325.9	381.8–433.9	10.2–3794.2	0.297
Ca intake (mg/week)	6444.1 ± 3113.5	6189.9–6698.2	733.5–21,386.9	0.008*

[a] Difference between values reported in the two studied cities

*P value <005

Table 2 Qualitative demographic data of the studied women

		Sannandaj	Arak	Total	*P* value
SES	High	39 (23.8)	125 (76.2)	164 (100)	0.029*
	Moderate	44 (20.8)	168 (79.2)	212 (100)	
	Low	65 (31.9)	139 (68.1)	204 (100)	
Menopause status	Premenopause	110 (25.6)	320 (74.4)	430 (100)	0.920
	Postmenopause	38 (25.2)	113 (74.8)	151 (100)	
Previous osteoporosis diagnosis	Yes	8 (28.6)	20 (71.4)	28 (100)	0.696
	No	140 (25.3)	414 (74.7)	554 (100)	
Compliance with osteoporosis drugs	Does not use any drug	140 (25.3)	414 (74.7)	554 (100)	0.319
	Non-compliant	7 (36.8)	12 (63.2)	19 (100)	
	Compliant	1 (11.1)	8 (88.9)	9 (100)	
Fx Hx in first-degree family	Yes	45 (19.7)	184 (80.3)	229 (100)	0.009*
	No	103 (29.3)	249 (70.7)	352 (100)	
Osteoporosis Fx in first-degree family	Yes	23 (19.5)	95 (80.5)	118 (100)	0.095
	No	125 (27.0)	338 (73.0)	463 (100)	
BMD classification	Normal	97 (26.3)	272 (73.7)	369 (100)	0.722
	Osteopenia	24 (30.4)	55 (69.6)	79 (100)	
	Osteoporosis	14 (29.2)	34 (70.8)	48 (100)	
Serum vit D level	Deficient	107 (26.7)	294 (73.3)	401 (100)	0.555
	Insufficient	12 (20.3)	47 (79.7)	59 (100)	
	Sufficient	11 (28.2)	28 (71.8)	39 (100)	

Hx history, *Fx* fracture

**P* value <005

495 (85.2%) of these women. In 7% of them, the patient herself had started the initiative for the discussion.

About 375 (64.5%) of these women did not receive the recommended daily amounts of calcium (Table 4). As for vitamin D, none of them met the RDA level. However, higher vit D intake ($R^2 = 0.127$, *P* value <0.01) was correlated with a better awareness level (Table 5). Physical activity ($R^2 = -0.087$, *P* value <0.05) was however negatively correlated with awareness level.

Table 3 Studied women's awareness level of different aspects of osteoporosis

		Sannandaj	Arak	Total	*P* value
K-FX	Poor	86 (58.1)	223 (51.5)	309 (53.2)	0.097
	Acceptable	62 (41.9)	210 (48.5)	272 (46.8)	
K-RF	Poor	145 (98.0)	363 (84.8)	508 (88.2)	<0.001*
	Acceptable	3 (2.0)	65 (15.2)	68 (11.8)	
K-PF	Poor	126 (93.3)	263 (64.5)	389 (71.6)	<0.001*
	Acceptable	9 (6.7)	145 (35.5)	154 (28.4)	
K-Total	Poor	142 (96.6)	331 (77.3)	473 (82.3)	<0.001*
	Acceptable	5 (3.4)	97 (22.7)	102 (17.7)	

**P* value <005

Thereafter, the factors influencing the awareness level were used to develop the final model (Table 6). The multivariate analysis revealed that each level increase in physical activity tertile increased the chance of having higher awareness level in K-FX class by 1.4 times. As for K-RF, each level increase in vit D intake tertile increased the chance of having higher awareness level by 1.5 times. Each level increase in sun exposure tertile lowered the chance of having higher awareness level in K-PF class by 30.3%, whereas each level increase in SES tertile lowered the chance of having higher awareness level by 45.6%. Each level increase in vit D intake tertile was also associated with a 1.5 times increased chance of having higher awareness level in this class. And finally, as for K-Total, each level increase in vit D intake tertile increased the chance of having higher awareness level by 1.5 times, and each level increase in physical activity tertile was associated with a 30.6% lower chance of having a good knowledge.

Discussion

Prevention is believed to be the core and the most cost-effective tool in fighting osteoporosis [14]. Adopting

Table 4 Awareness level in each category based on the studied women's characteristics and practice habits

		K-FX		K-RF		K-PF		K-Total	
		Poor	Good	Poor	Good	Poor	Good	Poor	Good
Menopausal status	Pre	233 (54.2)	197 (45.8)	374 (87.4)	54 (12.6)	282 (69.3)	125 (30.7)*	344 (80.6)	83 (19.4)*
	Post	76 (50.3)	75 (49.7)	134 (90.5)	14 (9.5)	107 (78.7)	29 (21.3)	129 (87.2)	19 (12.8)
Vit D intake	Low	107 (34.6)	86 (31.6)	173 (34.1)	18 (26.5)*	143 (36.8)	43 (27.9)	166 (35.1)	25 (24.5)*
	Mod	104 (33.7)	90 (33.1)	177 (34.8)	15 (22.1)	122 (31.4)	55 (35.7)	163 (34.5)	29 (28.4)
	High	98 (31.7)	96 (35.3)	158 (31.1)	35 (51.5)	124 (31.9)	56 (36.4)	144 (30.4)	48 (47.1)
Ca intake	Insuff	208 (67.3)	167 (61.4)	334 (65.7)	37 (54.4)	259 (66.6)	96 (62.3)	312 (66.0)	58 (56.9)
	Suff	101 (32.7)	105 (38.6)	174 (34.3)	31 (45.6)	130 (33.4)	58 (37.7)	161 (34.0)	44 (43.1)
SES	Low	122 (63.2)	71 (36.8)*	184 (95.3)	9 (4.7)*	145 (79.2)	38 (29.7)*	177 (91.7)	16 (8.3)*
	Mod	99 (50.8)	96 (49.2)	168 (87.0)	25 (13.0)	122 (68.9)	55 (31.1)	155 (80.3)	38 (19.7)
	High	89 (45.9)	105 (54.1)	157 (82.2)	34 (17.8)	122 (66.3)	62 (33.7)	141 (74.2)	49 (25.8)
BMD	NL	192 (52.0)	177 (48.0)	319 (86.7)	49 (13.3)	240 (69.0)	108 (31.0)	293 (79.8)	74 (20.2)
	Osteopenia	40 (50.6)	39 (49.4)	65 (85.5)	11 (14.5)	52 (27.2)	20 (27.8)	61 (80.3)	15 (19.7)
	Osteoporosis	22 (44.9)	27 (55.1)	44 (91.7)	4 (8.3)	33 (76.7)	10 (23.3)	41 (85.4)	7 (14.6)
Sun exposure	Low	121 (57.6)	89 (42.4)	188 (90.0)	21 (10.0)	145 (74.4)	50 (25.6)	176 (84.2)	33 (15.8)
	Mod	43 (53.8)	37 (46.3)	75 (93.8)	5 (6.3)	56 (74.7)	18 (24.3)	70 (87.5)	10 (12.5)
	High	56 (53.8)	48 (46.2)	93 (91.2)	9 (8.8)	89 (81.4)	18 (18.6)	87 (86.1)	14 (13.9)
Physical activity	Low	77 (56.2)	60 (43.8)	118 (86.8)	18 (13.2)	88 (70.4)	37 (29.6)	111 (81.6)	25 (18.4)*
	Mod	150 (54.3)	126 (45.7)	233 (85.3)	40 (14.7)	175 (67.3)	85 (32.7)	208 (76.2)	65 (23.8)
	High	64 (46.4)	74 (53.6)	128 (93.4)	9 (6.6)	103 (78.0)	29 (22.0)	124 (91.2)	12 (8.8)
Compliance	No drug	296 (53.4)	258 (46.6)	485 (88.3)	64 (11.7)	375 (72.0)	146 (28.0)	449 (81.9)	99 (18.1)
	Irreg	8 (42.1)	11 (57.9)	16 (84.2)	3 (15.8)	9 (52.9)	8 (47.1)	16 (84.2)	3 (15.8)
	Reg	6 (66.7)	3 (33.3)	8 (88.9)	1 (11.1)	5 (83.3)	1 (16.7)	8 (88.9)	1 (11.1)
Supplement use	Yes	55 (51.9)	51 (48.1)	95 (89.6)	11 (10.4)	74 (74.5)	24 (24.5)	93 (87.7)	13 (12.3)
	No	255 (53.6)	221 (46.4)	414 (87.9)	57 (12.1)	315 (70.6)	131 (29.4)	380 (80.9)	90 (19.1)
Previous osteoporosis diagnosis	Yes	14 (50.0)	14 (50.0)	24 (85.7)	4 (14.3)	14 (60.9)	9 (39.1)	24 (85.7)	4 (14.3)
	No	296 (53.4)	258 (46.6)	485 (88.3)	64 (11.7)	375 (72.0)	146 (28.0)	449 (81.9)	99 (18.1)

Mod moderate, *Insuff* insufficiency, *Suff* sufficiency, *NL* normal, *Irreg* irregular medication use, *Reg* regular medication use

**P* value <005

certain preventive measures, such as following a healthy diet rich in Ca and vit D, and engaging in regular exercise programs from young ages can promise healthy bones and lower risk of osteoporosis and its complications in the long run [15, 16]. The main barrier towards such behavior is low awareness of the disease and its risk factors. The problem is more challenging among women who are at a greater risk of experiencing the disease and its complications [17].

This is while our results revealed that only two (0.3%) of the studied women had never heard of osteoporosis but more than 81% of them had a poor knowledge of the disease and its complications. These results are in accordance with the findings of other studies revealing that a large number of women worldwide do not know much about osteoporosis and thus are not practicing well to prevent it [18, 19]. Juby et al. reported that while a large number of the elderly individuals involved in their study had already heard about osteoporosis, more than 61% of them could not provide a correct definition of the disease [20]. Mathews et al. reported that the majority of the American women had a low knowledge of osteoporosis and most of them did not consider the disease or the related fracture as a high-risk condition [21]. Sallam et al. also showed that most women believed that osteoporosis only starts at old ages and mainly after menopause [22]. In Puerto Rico, only 8% of the studied women had never heard of osteoporosis [23]. However, 1 in every 10 participants and 1 in every 5 did not know the risk factors and the complications, correspondingly.

Table 5 Correlation between awareness level in each category and the studied women's characteristics and practice habits

	K-FX	K-RF	K-PF	K-Total
Vit D intake	0.040	0.110**	0.073	0.127**
Ca intake	0.062	0.076	0.040	0.073
FH-OP	0.015	0.014	−0.015	0.012
FH-FX	0.048	0.001	−0.028	0.005
Physical activity	0.070	−0.072	−0.061	−0.087*
Sun exposure	0.038	−0.024	−0.076	−0.037
SES	0.064	0.019	−0.136**	−0.017
Menopausal status	0.034	−0.043	−0.090*	−0.076
Supplement use	−0.012	0.021	0.040	0.068
BMD status	0.045	−0.030	−0.061	−0.048
Vit D status	−0.039	0.034	−0.034	−0.022

FH family history

*Correlation is significant at the 005 level; **correlation is significant at the 001 level

On the other hand, similar to many other studies, our results revealed that while many of the studied women were concerned about being diagnosed with osteoporosis or knew fracture was the most important complication of osteoporosis, only a small number considered osteoporosis or its complications life-threatening or as serious as cancer [24].

This is while considering the national programs held by the Iranian Ministry of Health and Medical Education and medical schools in different parts of the country in the past years, a better awareness of the disease was expected [6, 7]. Our results, however, are consistent with that of other studies carried out in other parts of Iran in the past years [20, 25, 26]. Rafraf et al. showed that the majority of women in the childbearing age are not aware of osteoporosis risk factors [27]. In another study in the Kerman province, it was shown that more than one fifth of the studied women did not know about osteoporosis [28]. The ones with some knowledge of the disease were only aware of the female sex, smoking, and the consumption of corticosteroids as the risk factors of osteoporosis.

As not many studies have assessed awareness of osteoporosis among different Iranian groups, and the present study is the first such research to assess the matter on the studied cities, we were not able to decide about the efficacy of these programs; however, we could only conclude that today, nearly all of our subjects knew osteoporosis and similar to many other countries, media was the most important source of information [28]. Moreover, likewise other studies, family physician ranked much lower on the information list, suggesting that most physicians are not actively involved in patient education in the fight against osteoporosis [20, 29].

Similar to many of previous studies, the majority of our studied women did not exhibit a bone healthy behavior in many aspects of their life, which could be linked with their low awareness level [30]. About 89% of them were not engaged in any kind of exercise. While only 15.5% of them did not drink milk, more than 64% of them did not receive the RDA for Ca. This was worse for vit D, as none of the studied women received the RDA for vit D through food. These results corroborate with the fact that while 47% of the studied women knew about osteoporosis, only 13% of them were familiar with its risk and 44% with its preventive factors.

The worst bone status, however, was reported in the individuals with a better knowledge, and this could be contributed to the fact that many of these individuals started a healthy bone behavior after they were diagnosed with some degrees of bone loss. Our study, however, failed to show any influence of previous osteoporosis diagnosis on the awareness level. This could be due to the low number of such diagnoses among the studied individuals.

On the other hand, while some studies have shown an inverse correlation between Ca intake and osteoporosis, our results revealed that higher vit D intake, and not Ca intake, is associated with a better knowledge of osteoporosis [31, 32]. There are also controversial results regarding other factors affecting osteoporosis awareness level. Similar to our results, Vaytrisalova et al. failed to report any correlation between age and knowledge of the disease [33]. This is while Von Hurst and Wham reported that knowledge of osteoporosis was age-related, adding that the 30–39-year-old age group knew more about the disease [18]. Moreover, unlike previous studies, we failed to show any relation between SES and osteoporosis awareness, which shows that educational programs have addressed everyone regardless of their socioeconomic classes [34]. Furthermore, we could not find any correlation between educational level, supplement use and body mass index (BMI) values, and awareness level [32, 35].

Limitations

Considering the cross-sectional nature of this study, no causal association could be concluded from the results. Moreover, the subjects included in the current study were a subsample of those recruited for the IMOS study. While the sample size calculation and the sampling method were to ensure the generalizability of the IMOS results to the whole population in the studied cities, this might not be true for the subsample included in the current study. Further studies focusing on a larger number of subjects sampled for the very outcome are needed to confirm our results. On the other hand, the questionnaire was a self-administered survey, and thus, it is possible that some of the information reported by the individuals is not accurate.

Table 6 Factors influencing knowledge scores in the univariate and multivariate analysis

		Univariate analysis			Multivariate analysis		
		OR	CI 95%	*P* value	OR	CI 95%	*P* value
K-FX	Physical activity (tertile)	1.219	0.961–1.546	0.103*	1.396	1.021–1.909	0.037**
	Sun exposure (tertile)	1.095	0.867–1.384	0.446	–	–	–
	SES (tertile)	1.421	1.161–1.741	0.001*	1.197	0.970–1.477	0.093
	Ca intake (insuff/suff)	1.295	0.921–1.820	0.137*	1.302	0.916–1.851	0.141
	Vit D intake (tertile)	1.104	0.904–1.348	0.332	–	–	–
	BMD status (NL/osteopenia/osteoporosis)	1.149	0.876–1.508	0.316	–	–	–
	Menopausal status (pre/post)	1.167	0.805–1.692	0.414	–	–	–
	Supplement use (yes/no)	0.935	0.613–1.425	0.753	–	–	–
	Compliance (no drug/irreg/reg)	1.578	0.625–3.982	0.335	–	–	–
	Previous osteoporosis diagnosis (yes/no)	0.872	0.408–1.863	0.723	–	–	–
K-RF	Physical activity (tertile)	0.732	0.508–1.055	0.094*	0.729	0.505–1.052	0.091
	Sun exposure (tertile)	0.902	0.593–1.372	0.630	–	–	–
	SES (tertile)	1.950	1.392–2.732	<0.001*	1.005	0.722–1.398	0.979
	Ca intake (insuff/suff)	1.608	0.965–2.681	0.068*	1.195	0.656–2.177	0.560
	Vit D intake (tertile)	1.537	1.114–2.120	0.009*	1.475	1.007–2.161	0.046**
	BMD status (NL/osteopenia/osteoporosis)	1.102	0.544–2.232	0.788	–	–	–
	Menopausal status (pre/post)	0.724	0.389–1.345	0.306	–	–	–
	Supplement use (yes/no)	1.189	0.601–2.354	0.619	–	–	–
	Compliance (no drug/irreg/reg)	1.421	0.403–5.011	0.585	–	–	–
	Previous osteoporosis diagnosis (yes/no)	0.792	0.266–2.355	0.675	–	–	–
K-PF	Physical activity (tertile)	0.827	0.631–1.084	0.169*	0.827	0.562–1.219	0.338
	Sun exposure (tertile)	0.804	0.598–1.081	0.149*	0.697	0.500–0.971	0.033**
	SES (tertile)	1.378	1.094–1.734	0.006*	0.544	0.389–0.759	<0.001**
	Ca intake (insuff/suff)	1.204	0.817–1.774	0.349	–	–	–
	Vit D intake (tertile)	1.219	0.970–1.532	0.089*	1.516	1.098–2.094	0.012**
	BMD status (NL/osteopenia/osteoporosis)	0.855	0.487–1.502	0.585	–	–	–
	Menopausal status (pre/post)	0.611	0.386–0.970	0.037*	0.699	0.381–1.282	0.247
	Supplement use (yes/no)	1.282	0.775–2.121	0.333	–	–	–
	Compliance (no drug/irreg/reg)	2.283	0.864–6.031	0.096*	1.124	0.453–2.790	0.801
	Previous osteoporosis diagnosis (yes/no)	0.606	0.257–1.430	0.252	–	–	–
K-Total	Physical activity (tertile)	0.727	0.534–0.991	0.044*	0.704	0.511–0.970	0.032**
	Sun exposure (tertile)	0.879	0.624–1.239	0.463	–	–	–
	SES (tertile)	1.863	1.410–2.462	<0.001*	0.845	0.637–1.122	0.244
	Ca intake (insuff/suff)	1.470	0.951–2.273	0.083*	1.031	0.614–1.732	0.909
	Vit D intake (tertile)	1.517	1.158–1.988	0.003*	1.540	1.113–2.132	0.009*
	BMD status (NL/osteopenia/osteoporosis)	0.974	0.524–1.809	0.933	–	–	–
	Menopausal status (pre/post)	0.610	0.356–1.045	0.072*	0.600	0.339–1.060	0.078
	Supplement use (yes/no)	1.694	0.908–3.163	0.098*	1.600	0.816–3.138	0.172
	Compliance (no drug/irreg/reg)	0.850	0.243–2.975	0.800	–	–	–
	Previous osteoporosis diagnosis (yes/no)	1.323	0.449–3.898	0.612	–	–	–

insuff insufficiency, *suff* sufficiency, *NL* normal, *irreg* irregular medication use, *reg* regular medication use

**P* value <02; ***P* value <005

Conclusion

In order to improve bone health in the society and encourage individuals to get involved into preventive measures against osteoporosis, the first step is to spread osteoporosis awareness in different age groups. This is more important in female households considering their critical role in the family.

As a result, more educational programs, targeting women, are needed to promote bone healthy behavior [36, 37]. Moreover, the content or the delivery style of the current programs should be optimized to improve the outcome. In either case, these programs should mainly focus on the effects of these three main groups on osteoporosis in order to achieve the best result [38]:

- Personal characteristics: age, BMI, education level, and SES.
- Behavior: physical activity and sun exposure.
- Nutrition: daily Ca and vit D intake and supplement use.

Compliance with ethical standards

Conflicts of interest None.

References

1. Fuleihan GE, Adib MG, Nauroy L. The Middle East & Africa Audit 2011. 2011
2. Ebrahimi M, Khashayar P, Keshtkar A, Etemad K, Dini M, Mohammadi Z et al (2014 Jul) Prevalence of vitamin D deficiency among Iranian adolescents. J Pediatr Endocrinol Metab 27(7–8): 595–602
3. Hashemipour S, Larijani B, Adibi H, Javadi E, Sedaghat M, Pajouhi M et al (2004 Aug) Vitamin D deficiency and causative factors in the population of Tehran. BMC Public Health 4:38
4. Shams J, Spitzer AB, Kennelly AM, Tosi LL (2011 Aug) Bone quality: educational tools for patients, physicians, and educators. Clin Orthop Relat Res 469(8):2248–2259
5. SM O, Song BM, Nam B-H, Rhee Y, Moon S-H, Kim DY et al (2016) Development and validation of osteoporosis risk-assessment model for Korean men. Yonsei Med J Vol. 57:187–196
6. Winzenberg TM, Oldenburg B, Frendin S, Jones G (2003) The design of a valid and reliable questionnaire to measure osteoporosis knowledge in women: the Osteoporosis Knowledge Assessment Tool (OKAT). BMC Musculoskelet Disord 4:17
7. Lorbergs AL, Holland A (2016) Falling between the cracks: attitudes and perceptions toward osteoporosis prevention among postmenopausal women. J Osteopor Phys Act [Internet] 4:168 Available from: http://www.esciencecentral.org/journals/falling-between-the-cracks-attitudes-and-perceptions-toward-osteoporosisprevention-among-postmenopausal-women-2329-9509-1000169.php?aid=70696
8. Abbasi-Shavazi MJ, Morgan SP, Hossein-Chavoshi M, McDonald P (2009) Family change and continuity in Iran: birth control use before first pregnancy. J Marriage Fam [Internet] 71(5):1309–1324 Available from: http://www.ncbi.nlm.nih.gov/pubmed/20376280
9. Nasiri Z (2017) A study of the effects of globalization on Iranian families. Int Res J Appl Basic Sci 7(14):1155–1163 Available from: www.irjabs.com
10. Schettler AE, Gustafson EM (2004) Osteoporosis prevention starts in adolescence. J Am Acad Nurse Pract 16(7):274–282 Available from:http://doi.wiley.com/10.1111/j.1745-7599.2004.tb00450.x
11. Keshtkar A, Khashayar P, Mohammadi Z, Etemad K, Dini M, Aghaei Meybodi H et al (2015) A suggested prototype for assessing bone health. Arch Iran Med 18(7):411–415
12. Heshmat R, Mohammad K, Majdzadeh S, Forouzanfar M, Bahrami A, Omrani GR, et al. Vitamin D deficiency in Iran: a multi-center study among different urban areas. 2008;(1):72–8.
13. Dawson-Hughes B (2015) Calcium and vitamin D for bone health in adults. In: Holick FM, Nieves WJ (eds) Nutrition and Bone Health [Internet]. Springer New York, New York, NY, pp 217–230 Available from: doi:10.1007/978-1-4939-2001-3_14
14. Orces CH, Casas C, Lee S, Garci-Cavazos R, White W (2003) Determinants of osteoporosis prevention in low-income Mexican-American women. South Med J 96(5):458–464
15. Carey DE, Golden NH (2015) Bone health in adolescence. Adolesc Med State Art Rev 26(2):291–325
16. Hazavehei SM, Taghdisi MH, Saidi M (2007) Application of the health belief model for osteoporosis prevention among middle school girl students, Garmsar, Iran. Educ Health (Abingdon) 20(1):23
17. Cadarette SM, Gignac MAM, Beaton DE, Jaglal SB, Hawker GA (2007) Psychometric properties of the "Osteoporosis and You" questionnaire: osteoporosis knowledge deficits among older community-dwelling women. Osteoporos Int 18(7):981–989
18. von Hurst PR, Wham CA (2007) Attitudes and knowledge about osteoporosis risk prevention: a survey of New Zealand women. Public Health Nutr 10(7):747–753
19. Ungan M, Tumer M (2001) Turkish women's knowledge of osteoporosis. Fam Pract 18(2):199–203
20. Juby AG, Davis P. A prospective evaluation of the awareness, knowledge, risk factors and current treatment of osteoporosis in a cohort of elderly subjects. Osteoporos Int. 2001;
21. Matthews HL, Laya M, DeWitt DE (2006) Rural women and osteoporosis: awareness and educational needs. J Rural Health [Internet] 22(3):279–283 Available from: http://www.ncbi.nlm.nih.gov/pubmed/16824177
22. Sallam H, Galal AF, Rashed A (2006) Menopause in Egypt: past and present perspectives. Climacteric 9(6):421–429
23. Monsanto HA (2010) Level of awareness about osteoporosis among women 50 years and older in Puerto Rico. P R Health Sci J 29(1):54–59
24. Saw S-M, Hong C-Y, Lee J, Wong M-L, Chan M-F, Cheng A et al (2003) Awareness and health beliefs of women towards osteoporosis. Osteoporos Int [Internet] 14(7):595–601 Available from: doi:10.1007/s00198-003-1403-6
25. Clark P, Lavielle P (2015) Risk perception and knowledge about osteoporosis: well informed but not aware? A cross-sectional study. J Community Health 40(2):245–250
26. Lewin KJ, Sinclair HK, Bond CM (2003) Women's knowledge of and attitudes towards hormone replacement therapy. Fam Pract 20(2):112–119
27. Rafraf M, Bazyun B, Afsharnia F (2009) Osteoporosis-related life habits and knowledge about osteoporosis among women in Tabriz. Iran Int Med J Malaysia 8(2):17–20
28. Jalili Z, Nakhaee N, Askari R, Sharifi V (2007) Knowledge, attitude and preventive practice of women concerning osteoporosis. Iran J Publ Heal 36(2):19–24
29. Puttapitakpong P, Chaikittisilpa S, Panyakhamlerd K, Nimnuan C, Jaisamrarn U, Taechakraichana N (2014) Inter-correlation of knowledge, attitude, and osteoporosis preventive behaviors in women around the age of peak bone mass. BMC Womens Health [Internet] 14(1):35 Available from: http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=3942254&tool=pmcentrez&rendertype=abstract
30. Prevention NIHCDP on O (2001) Diagnosis, therapy and osteoporosis prevention, diagnosis, and therapy. JAMA [Internet] 285(6): 785–795 Available from: doi:10.1001/jama.285.6.785
31. Liew YL, Mann D, Piterman L (2002) Osteoporosis risks. A comparative study of Asian Australian and Caucasian Australian women. Aust Fam Physician 31(3):291–293,297

32. Kim KH, Lee K, Ko Y-J, Kim SJ, Oh SI, Durrance DY et al (2012) Prevalence, awareness, and treatment of osteoporosis among Korean women: the Fourth Korea National Health and Nutrition Examination Survey. Bone [Internet] 50(5):1039–1047. doi:10.1016/j.bone.2012.02.007
33. Vytrisalova M, Kubena A, Vlcek J, Palicka V, Hala T, Pavelka K (2007) Knowledge of osteoporosis correlated with hormone therapy use and health status. Maturitas 56(1):21–29
34. Kutsal YG, Atalay A, Arslan Ş, Başaran A, Cantürk F, Cindaş A et al (2005) Awareness of osteoporotic patients. Osteoporos Int 16(2):128–133
35. Shin H-Y, Kang HC, Lee K, Park SM, H-Y S, HC K et al (2014) Association between the awareness of osteoporosis and the quality of care for bone health among Korean women with osteoporosis. BMC Musculoskelet Disord [Internet] 15(1):334 Available from: doi: 10.1186/1471-2474-15-334
36. Aree-Ue S, Pothiban L, Belza B, Sucamvang K, Panuthai S (2006) Osteoporosis preventive behavior in Thai older adults: feasibility and acceptability. J Gerontol Nurs 32(7): 23–30
37. Kamjoo A, Shahi A, Dabiri F, Abedini S, Hosseini Teshnizi S, Pormehr Yabandeh A. The effectiveness of education about osteoporosis prevention on awareness of female students.
38. Toh LS, Lai PSM, Wu DBC, Wong KT, Low BY, Anderson C (2015) The development and validation of the Osteoporosis Prevention and Awareness Tool (OPAAT) in Malaysia. PLoS One 10(5):1–19